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No. III. — ON THE EFFECT OF ARMATURES ON THE MAGNETIC STATE OF ELECTRO-MAGNETS.

By B. O. Peirce and E. B. Lefavour.

M. Jamin has lately shown that the effect in providing a steel magnet with an armature consists merely in a redistribution of magnetism, but not in an increase. The following experiments were instituted, to determine what was the effect of armatures of electro-magnets on their magnetic state. The method of experimenting was to slip a coil of fine wire over the electro-magnet, which was provided with a scale, and to measure by the swing of the needle of a reflecting galvanometer the induction currents which arise on making and breaking the circuit of the electro-magnet. The first experiments were made with a straight electro-magnet, 19 cm. long, 1.5 cm. wide. The core consisted of a bundle of fine iron wires, the ends of which were filed in one plane, upon which the armature, which consisted of a piece of iron 6 cm. long, 1.5 cm. wide, rested. It was found that the mass of this armature made no difference, as long as the end of the core of the electro-magnet was completely covered, and in close contact with the armature. The following table gives the results obtained. Only the currents produced by breaking the primary circuit are given.

TABLE I.

Distance along the Electro-Magnet.	Deflections without Armature.	Deflections with Armature.
1	100	130
2	118	132
8	126	140
4	135	148
5	142	166
6	150	176
7	157	178
8	156	178
9	157	160
10	157	160
11	153	178
12	148	176
13	140	171
14	125	166
15	112	156
16	100	145

When these results are represented by curves, they show that the magnetic state, in a straight electro-magnet without an armature, increases from both ends towards the middle (which was shown to be the case by Jacobi and Lenz in 1844); and when the armature is applied, the curves diverge greatly near the pole upon which the armature is placed.

Our next experiments were tried with a solid horseshoe-shaped electro-magnet, the limbs of which were 12 cm. long, 2.5 cm. in diameter; the resistance of the electro-magnet was about .01 of an ohm and that of the induction coil 1 ohm.

TABLE II.

Distance on limb of Magnet.	Deflections without Armature.	Deflections with Armature.
1	102	211
2	103	220
3	105	220
4	105	228
5	105	228
6	103	225
7	96	224
8	89	222
9	81	220
10	75	219
11	65	216
12	51	207

The scale runs, increasing, from the bend of the electro-magnet to the pole of the limb on which the induction coil was slipped. Here there is a marked increase, resulting from the use of the armature, which is shown in a striking manner by expressing the above results as curves. The results of our experiments show: —

1st. The application of an armature to one pole of a straight electro-magnet results in an increase of the magnetic condition of the magnet.

2d. The application of an armature to both poles of a horseshoe-shaped magnet results in a remarkable increase of its magnetic state, which increase is much the greatest near the armature.